MultiplEYE Final Conference
August 20-21, 2026
Skopje, North Macedonia

BRAIN ACTIVITY CORRELATIONS IN READING: AN ONGOING STUDY WITH FNIRS AND EYE-TRACKING COREGISTRATION

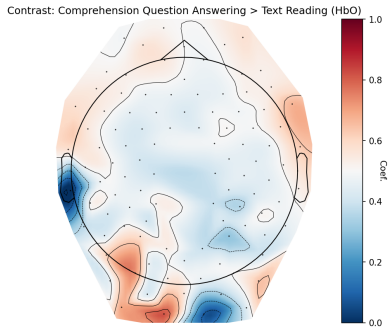
Cengiz Acartürk*[1], Anna Maria Wilkosz[1], Melike Çağlayan[1], Jakub Romanowski[1]

[1]Centre for Cognitive Science, Jagiellonian University, Poland

*contact: cengiz.acarturk@uj.edu.pl

In the study of eye-movements during reading, a significant gap remains in understanding the relationship between eye-movement patterns and comprehension of text. In the present study, we address this gap by employing coregistration of fNIRS (functional Near-Infrared Spectroscopy) and eye tracking during reading of Polish texts and answering comprehension questions. The central research question has been whether it would be possible to discriminate between the brain activity during reading text and during answering comprehension questions, and to identify eye-movement variables that might correlate with the brain activity, as measured by fNIRS.

Alongside being an indicator of a set of cognitive states in clinical settings, the changes in blood oxygenation have been interpreted as indirect indicators of cognitive load and attention, including studies in reading (Quaresima *et al.*, 2012). The fNIRS is an optical neuroimaging methodology (Jöbsis, 1977), designed for measuring brain activity by detecting changes in hemoglobin concentration, thus blood oxygenation, using near-infrared light (Villringer *et al.*, 1993). Although fNIRS provides inferior whole-brain spatial resolution compared to fMRI (functional Magnetic Resonance Imaging), it offers portability, high temporal resolution, and motion tolerance suitable for measuring activity of the cortical surface. For coregistration of fNIRS and eye tracking, we designed an experiment in which text-reading blocks are followed by comprehension-question blocks, and the eye-tracking and fNIRS measures can be separated for the specific task blocks.



Regarding the expected findings, we anticipate correlations between localized oxygenation and specific oculomotor behaviors, such as pupil dilation. From a methodological point of view, our initial findings show that the coregistration of fNIRS and eye-tracking has the potential to allow researchers to measure and interpret eye-movement patterns in relation to comprehension indicators, especially pupillometry and brain activity. Additionally, the initial results have shown that it is possible to discriminate between text-reading sessions and comprehension-question sessions in terms of fNIRS variables alongside eye-movement variables, as exemplified in the figure.

Consequently, this ongoing study aims to expand global multilingual reading datasets, by bridging the existing gap between linguistics-oriented research and cognitive science, and inform the next generation of psychophysiologically grounded computational reading models.

References

Jöbsis F. F. (1977). Noninvasive, infrared monitoring of cerebral and myocardial oxygen sufficiency and circulatory parameters. *Science 198*(4323), 1264–1267.

Quaresima V., Bisconti S., Ferrari M. (2012). A brief review on the use of functional near-infrared spectroscopy (fnirs) for language imaging studies in human newborns and adults. *Brain and language 121*(2), 79–89.

Villringer A., Planck J., Hock C., Schleinkofer L., Dirnagl U. (1993). Near infrared spectroscopy (nirs): a new tool to study hemodynamic changes during activation of brain function in human adults. *Neuroscience letters 154*(1-2), 101–104.